PCT / AU 00 / 942 10/049141

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CERTIFICATE

4

This certificate is issued in support of an application for Patent registration in a country outside New Zealand pursuant to the Patents Act 1953 and the Regulations thereunder.

I hereby certify that annexed is a true copy of the Provisional Specification as filed on 6 August 1999 with an application for Letters Patent number 337089 made by MAHANGA HOLDINGS LIMITED.

I further certify that pursuant to a claim filed on 4 April 2000 under Section 24(1) of the Patents Act 1953, a direction that the application proceeds in the name of QEI, Inc. by virtue of a deed dated 17 December 1999.

Dated 8 May 2000.

COMMISSIONER OF PATENTS, TRADE MARKS & DESIGNS NEW ZEALAND

Neville Harris

Neville Harris
Commissioner of Patents

337089

Patents Form # 4

NEW ZEALAND

Patents Act 1953

PROVISIONAL SPECIFICATION

Title: Switch Actuator

We, ***Mahanga Holdings Limited***
Nationality: *New Zealand company*
Address: *Unit 11/95 Ellice Road, Glenfield, Auckland 1330, New Zealand,*
do hereby declare this invention to be described in the following statement :

FEE CODE – 1040

Title: SWITCH ACTUATOR

FIELD OF THE INVENTION

This invention relates to an actuator for high voltage air break electrical switches.

BACKGROUND OF THE INVENTION

Prior art air break switches are relatively large switches which require significant force to operate. Such switches are usually mounted on top of power poles and are designed to immediately break the power supply along an overhead high voltage distribution line or number of lines. Present air break switches are activated by manually operated handles. These handles are located at the base of a power pole to which access is only available to authorised maintenance crews. Prior art air break switch actuators usually comprise a lever mechanism biased to open or close a switch and to hold the switch in the open or closed position. The biasing action is normally due to a powerful spring under compression between two points corresponding to the switch's open or closed positions. The spring applies force in either direction away from a position between the open and close positions to the lever operating the switch which is also held in the open or closed position by the force of the spring. This introduces certain problems mainly that when the actuator is driven in a reverse direction, the spring pressure is relieved from the air break switch for the time that the spring travels to a changeover point. At the changeover point the spring commences to open or close the switch by applying force in the relevant direction. The problem is when spring force which is holding the switch closed is removed the switch contacts for this brief period are only held together by gravity with the potential for arcing should they commence

to separate due to some external force or pressure. Importantly, the force required to open a switch is greater than the force required to close a switch. As a result, actuators therefore are limited to springs which are large enough to provide enough force to open the switch. It is the inventor's observation that prior art actuators do not have the ability to vary the spring force as required to open or close the switch so that more compact and springs which apply less force to the switch mechanism can be used. In addition, as prior art actuators have an exposed sliding slot mechanism, they are prone to be vandalised and can be affected by adverse weather conditions such as the mechanism icing up, being corroded by salt in a marine environment and/or jamming due to the nesting activities of birds and bird droppings.

Utilising existing ball screw linear drives and associated electronics, it is now possible to operate air break switch actuators remotely by means of radio control. This negates the necessity for maintenance crew have to travel to a fault site in order to operate the air break switch to disconnect power along the relevant faulty line or lines. The switch can be actuated well in advance to limit or prevent further damage to the grid and to isolate faulty sections of line. The introduction of remote control mechanisms, however requires efficient and smooth operation of the actuator apparatus. Prior art switch actuators which may be affected by weather, vandals or jammed by other factors present a significant reliability problem in terms of remote or radio controlled operation.

OBJECT OF THE INVENTION

It is therefore an object of the present invention to alleviate to some degree some of the problems associated with prior art air break switch actuators or to at least provide the public with a useful choice.

SUMMARY OF THE INVENTION

According to one aspect, the invention resides in an air break switch actuator including in combination:

a housing adapted to enclose in position,

a switch actuating means adapted to move between a first and a second position corresponding to an open or a closed position, or vice versa, of a switch,

operating means to operate said actuating means, the operating means manually operable and/or driven by a linear drive unit,

releasable locking means adapted to lock the actuating means in either the first or the second position,

biasing means adapted to apply a biasing force to urge the actuating means to either the first or the second position,

linkage means coupling the operating means with the locking means and the biasing means, the linkage means adapted to change the direction and strength of the biasing force between said first and second portions,

wherein in operation, the operating means disengages the locking means and causes the actuating means to move from the first to the second position and at the same time overcoming the biasing force of the biasing means; the linkage means changing the direction

and strength of the biasing force to urge the actuating means from the first to the second position, the locking means then re-engaging and locking the actuating means in the second position, the operation repeatable between first and second positions as required.

Preferably the actuating means comprises a switch lever movable between two positions and joined to a slotted switch plate, the switch lever connected by connecting rods or other means to open or close the air break switch.

Preferably the operating means includes a manually or motor driven crank, the crank connected to a motor plate having slots which at least in one position is in corresponding alignment with the slots of the switch plate, the motor plate engaging the switch plate by means of a spring plate intermediate the motor plate and the switch plate wherein the spring plate has transverse pins engaging the slots of the motor and switch plates, the motor plate, spring plate and switch plate in coaxial alignment and rotatable about an axial shaft.

Preferably the axial shaft is contiguous with the switch plate and the switch lever and also provides axial support for the spring and motor plates.

Preferably the linear drive unit is a linear electrical actuator with a mechanical clutch at both ends of travel to prevent damage to the actuator in the event of jamming or failure of any of the actuator's components. Such an electrical linear actuator enables the spring actuator to be remotely operated.

Preferably the locking means comprises one or more pawl members pivotal about an axial member at one end and having one or more sprags engageable with notches in the switch

plate. The sprags of the pawl members disengageable from the notches by means of a cam action of the spring plate whereby one or more cam lobes on the spring plate in contact with one or more cam following portions of the pawl members pivots the pawl members away from the switch plate.

The biasing means is preferably a spring under compression operating through a lever connected by an extension arm to a lug on the spring plate.

The crank operating through the linkage members compresses the spring and cause the spring plate to rotate from the first to the second position until the direction of the spring's force is changed by the linkage members so that the compression of the spring is released to drive the spring plate and the switch plate to the second position. On reaching the second position the pawl members are re-engaged with the switch plate thereby locking the switch plate in the second position.

To return the switch plate to the first position, the order of the operation is reversed by the crank to change the rotation of the spring plate in the direction of the first position wherein the pawl members are disengaged from the switch plate by the cam action of the spring plate. The spring is recompressed until the direction of the spring force is changed by the linkages member wherein the spring is again released from its compressed state to return the spring plate and the switch plate to the first position.

The strength of the spring force being greater in one direction depending on the arrangement of the linkage members.

Preferably the biasing means includes adjustment means for adjusting the tension of the spring.

Preferably the engagement of the sprags of the pawl members with the notches of the switch plate is under spring tension and is adjustable.

BRIEF DESCRIPTIONS OF THE DRAWINGS

In order that this invention may be more readily understood and put into practical effect, reference will now be made to the accompanying drawings which illustrate a preferred embodiment of the invention and wherein:

Figure 1: is an illustration of the air break switch actuator in situ according to the invention.

Figures 2 - 5: show the action of the air break switch actuator of Figure 1

Figures 2a-5a: show the relative positions of the switch lever and the motor lever corresponding to Figures 2 - 5, and

Figure 6: shows a transverse section of part of the actuating means according to the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring to Figure 1 there is shown an air break switch 2 located on the top of a power pole 3. The switch is connected to the air break switch actuator 4 according to this invention by

means of connecting rod 5. The connecting rod is connected to the switch lever 4a of the actuator. The motor lever 4b is connected to a linear actuator drive unit 8 which has a manual operating mechanism comprising an adjustable extension 8a coupled to a lever mechanism 8b. The actuator is shown with a remote control facility 9 to enable radio controlled activation of the actuator.

Referring now to Figure 2 there is shown in plan view of components of an air break switch actuator 10 according to the invention wherein one side of the housing has been removed and where the switch (not shown) is in the closed position. In this view, the switch lever which is connected to the switch plate 16 and the motor lever connected to crank 37 are also not shown.

The spring plate 24 which underlies the switch plate 16 engages the switch plate by means of pins 26, 28 in the slots 29, 30 of the switch plate. The spring plate lug 32 is connected by extension arm 34 and crank pin 35 to lever 36. Counter clockwise rotation of crank 37 by the linear drive unit (not shown) compresses spring 38 located in position by threaded member 40. The threaded member has reduced portion 41 which is slidably and pivotally located in spacer member 42. The spring plate has raised portions or cam lobe sections 31 to effect a cam like action on the pawl member 12. The pawl member is connected to lever 36 by means of an extension rod 46 having tension adjustment means comprising lock nut 50, adjusting nut 41 and spring 43. The extension rod 46 is pivotally and slidably connected with respect to a spacer 52. The switch is locked in this position by the pawl member 12 shown with the sprag 13 of the pawl engaging notch 14 in the switch plate 16 thereby preventing the switch plate from rotating in the clockwise direction. The spring 38 is

adjustable by means of nut 52 on the threaded rod. Movement of the spring plate and thereby the switch plate between open and closed positions of the switch (not shown) is limited by the lug 32 coming into contact with spaces 54, 56. It is evident from this arrangement that a counter clockwise rotation of the crank 37 effects a clockwise rotation of the spring plate 24 and hence the switch plate 16.

Figure 2a shows the relative positions of the switch lever 20 and motor lever 22 in the above situation. Both the switch and the linear drive unit which are connected to the switch lever and the motor lever, respectively are not shown.

Figure 3 shows clockwise rotation 58 of the spring plate 24 and the switch plate 16 towards a switch open position by the further counter clockwise rotation of crank 37. Pawl member 12 is disengaged by counter clockwise rotation of crank 37 causing clockwise rotation of spring plate 24 as shown by arrow 58. The cam lobe 31 of the spring plate comes into contact with a cam following portion 60 of the pawl member to lift the pawl member and release the sprag 13 from the notch 14 of the switch plate. The switch plate is rotated by the spring plate by means of pins 26, 28 of the spring plate engaging slots 29, 30 of the switch plate. The clockwise rotation of the spring plate causes the extension arm pin 35 to engage the finger 62 of the lever 36 causing the upward movement of the extension arm 34 as shown by arrow 64 thereby also enabling the disengagement of sprag 13 of the pawl member from notch 14. At the same time counter clockwise rotation of crank 37 causes spring 38 to be compressed and the spring plate to travel towards a position marked, "x".

Figure 3b shows the relative positions of the switch lever 20 and motor lever 22 for this situation.

Figure 4 shows the spring plate 24 which has rotated pass the position marked "x" wherein the spring 38 has been allowed to decompress thereby urging the spring plate via extension arm 34 to rotate in the clockwise direction until lug 32 is in contact with spacer 56. The spring plate in this position causes the switch plate 16 and switch lever (not shown) to open the switch (not shown). The sprag 63 of pawl member 64 is shown engaging the second notch 66 of the switch plate thereby locking the switch (not shown) in the open position. Spring 38 is fully extended in this position. Figure 4b shows the relative positions of the motor lever 22 and the switch lever 20 for this position.

Figure 5 shows the counter rotation of the spring plate 24 in the direction of arrow 27 towards the switch closed position of Figure 1. Cam lobe 31 of the spring plate 24 by engaging with the cam following section 60 of the pawl member disengages sprag 63 of pawl member 64 from the notch 66 of the switch plate. As the spring plate rotates in the counter clockwise direction 27 towards the position marked "x" (obscured by the lug 32) the spring 38 is recompressed by the action of crank 37. The spring is released once the lug has passed the position "x" so that it assumes a fully decompressed state when the spring plate and the switch plate are returned to the first position as shown in Figure 1. The switch plate is rotated by means of the pins 26, 28 of the spring plate engaging the slots 29, 30 of the switch plate. Figure 4a shows the relative positions of the motor 22 and switch levers 20 for this position.

It will be evident from the above arrangement that the force applied by the spring in the direction of the switch in the closed position as shown by Figure 2 is greater than the force applied by the spring when the switch is in the open position as shown in Figure 4. This is a consequence of the geometry of the linkage members 36, 37 and 42.

Referring to Figure 6 there is shown the switch lever 80 which is in coaxial relation with motor lever 82, motor plate 84, switch plate 86 and spring plate 100. The motor plate 84 and the switch plate 86 are connected by means of their respective slots 88, 90 and 92, 94 via the transverse pins 96, 98 of the spring plate 100 located between the switch plate and the motor plate. The locking mechanism of the pawl members or the spring and linkage means are not shown in this diagram. In this embodiment, the central shaft 102 which co-axially aligns the switch, motor and spring plates is contiguous with the switch lever 80.

ADVANTAGES OF THE PREFERRED EMBODIMENT

The advantages of the preferred embodiment include its enclosed structure which is not exposed to either the weather or the possibility of interference by vandals. The air break switch actuator as hereinabove described can be used to isolate sections of high voltage power distribution networks.

The locking of the actuator in the switch open or closed position is an advantage which overcomes the possibility of arcing or partial disconnection due to the bending or warping of the power pole on which the actuator and switch are located. As previously discussed, as prior art air break switch actuators presently rely on the strength of the spring in order to close or open the switch, there is possibility that contact can be broken if the spring breaks or the power pole bends or is warped. The locking means of the invention ensures that electrical contact is maintained irrespective of the force of the spring or biasing means. The smoother operation of the present invention also allows motor drives and other screw jack means to operate air break switches efficiently and with reduced possibility of failure. Other

advantages include the ability to replace existing prior art switch actuators currently in use with the present invention which has identical or substantially similar outer dimensions.

VARIATIONS

Finally it will be appreciated that various other alterations and modifications may be made to the foregoing without departing from the scope of this invention as set forth.

PIPERS
Attorneys for the Applicant
MAHANGA HOLDINGS LIMITED

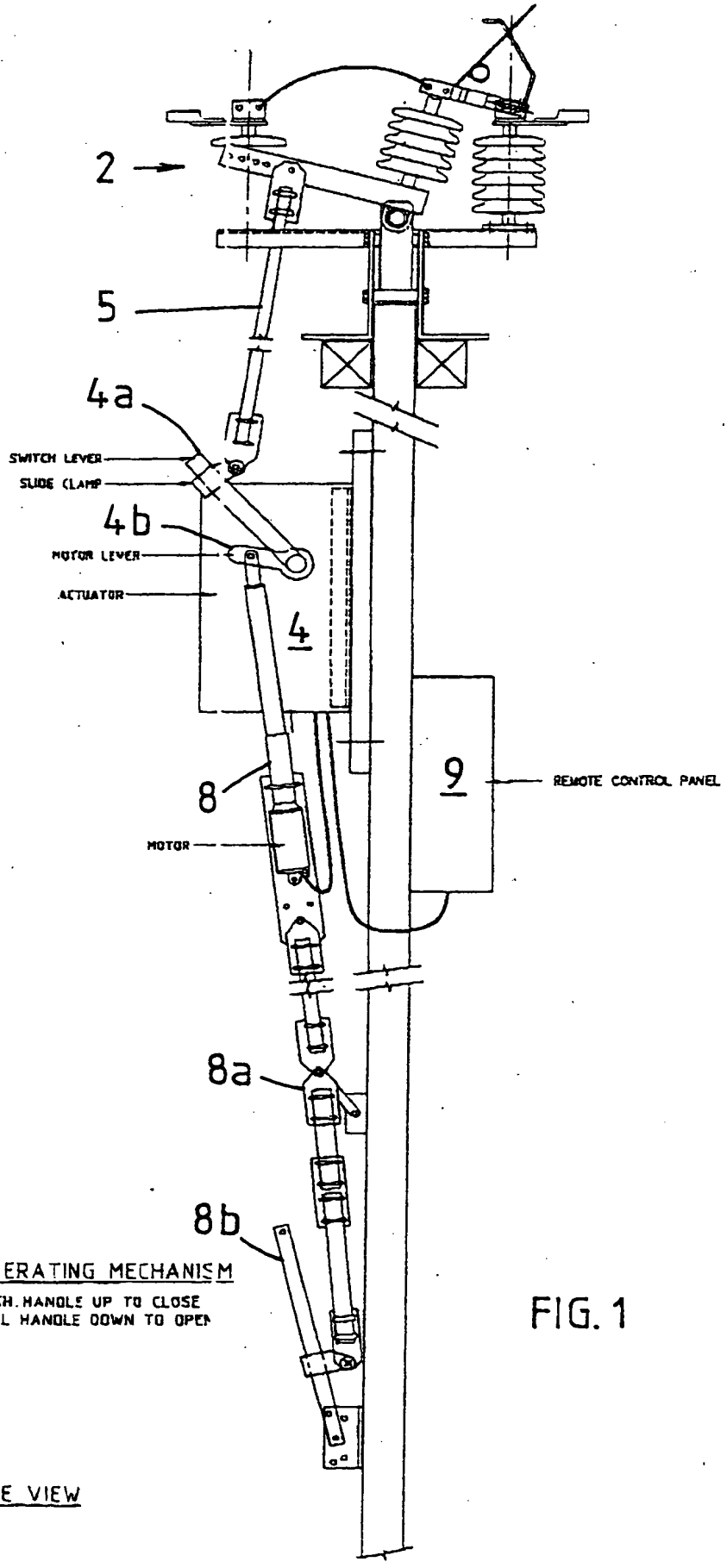

2
5
4a
SWITCH LEVER
SLIDE CLAMP
4b
MOTOR LEVER
ACTUATOR
4
9
REMOTE CONTROL PANEL
8
MOTOR
8a
8b
OPERATING MECHANISM
PUSH HANDLE UP TO CLOSE
PULL HANDLE DOWN TO OPEN
SIDE VIEW

FIG. 1

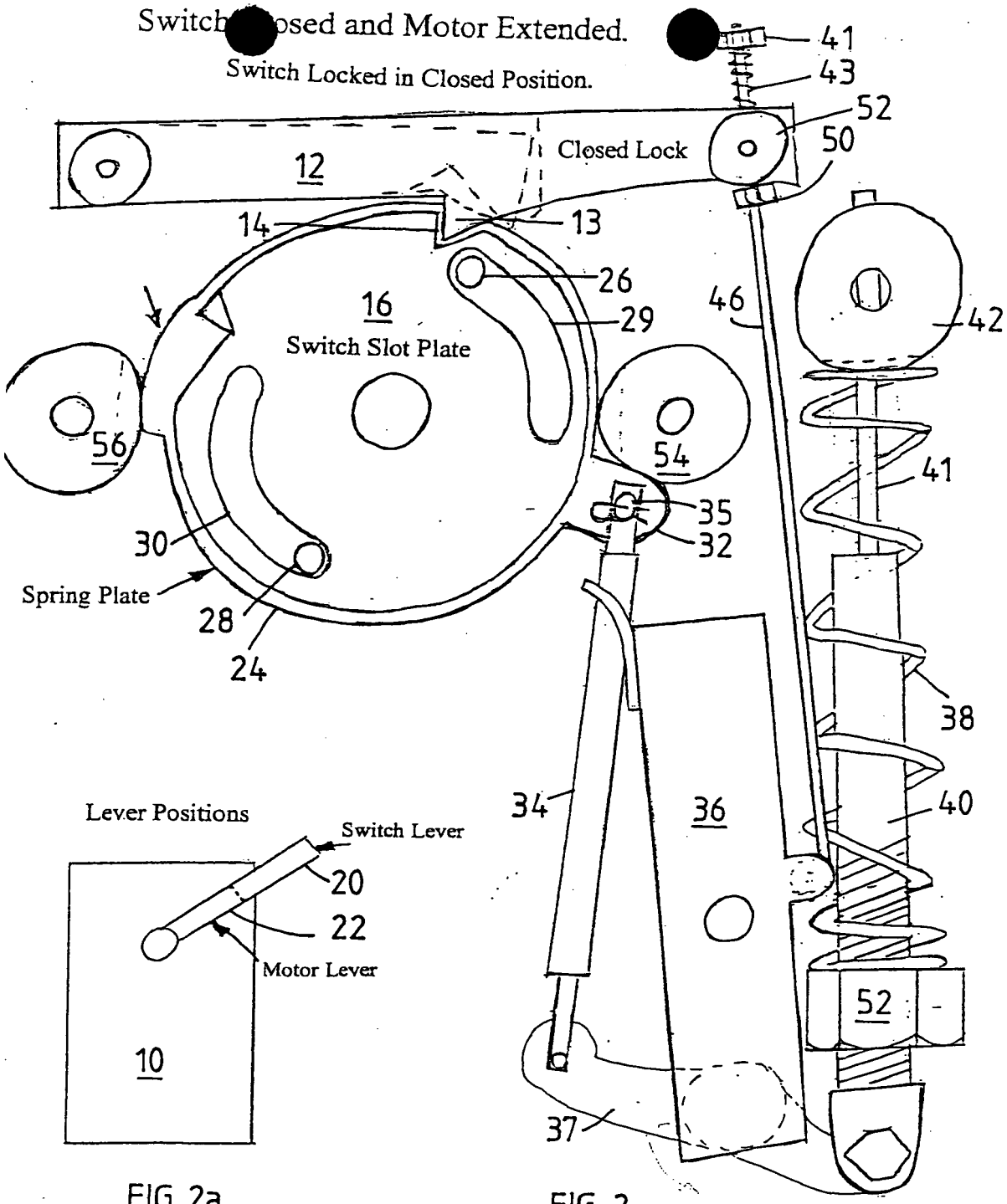

Switch Closed and Motor Extended.
Switch Locked in Closed Position.
41
43
52
50
Closed Lock
12
14
13
26
29
46
42
16
Switch Slot Plate
56
54
41
35
32
30
Spring Plate
28
24
38
34
36
40
52
37

FIG. 2

Lever Positions
Switch Lever
20
22
Motor Lever
10

FIG. 2a

Switch Clos Motor Contracting.

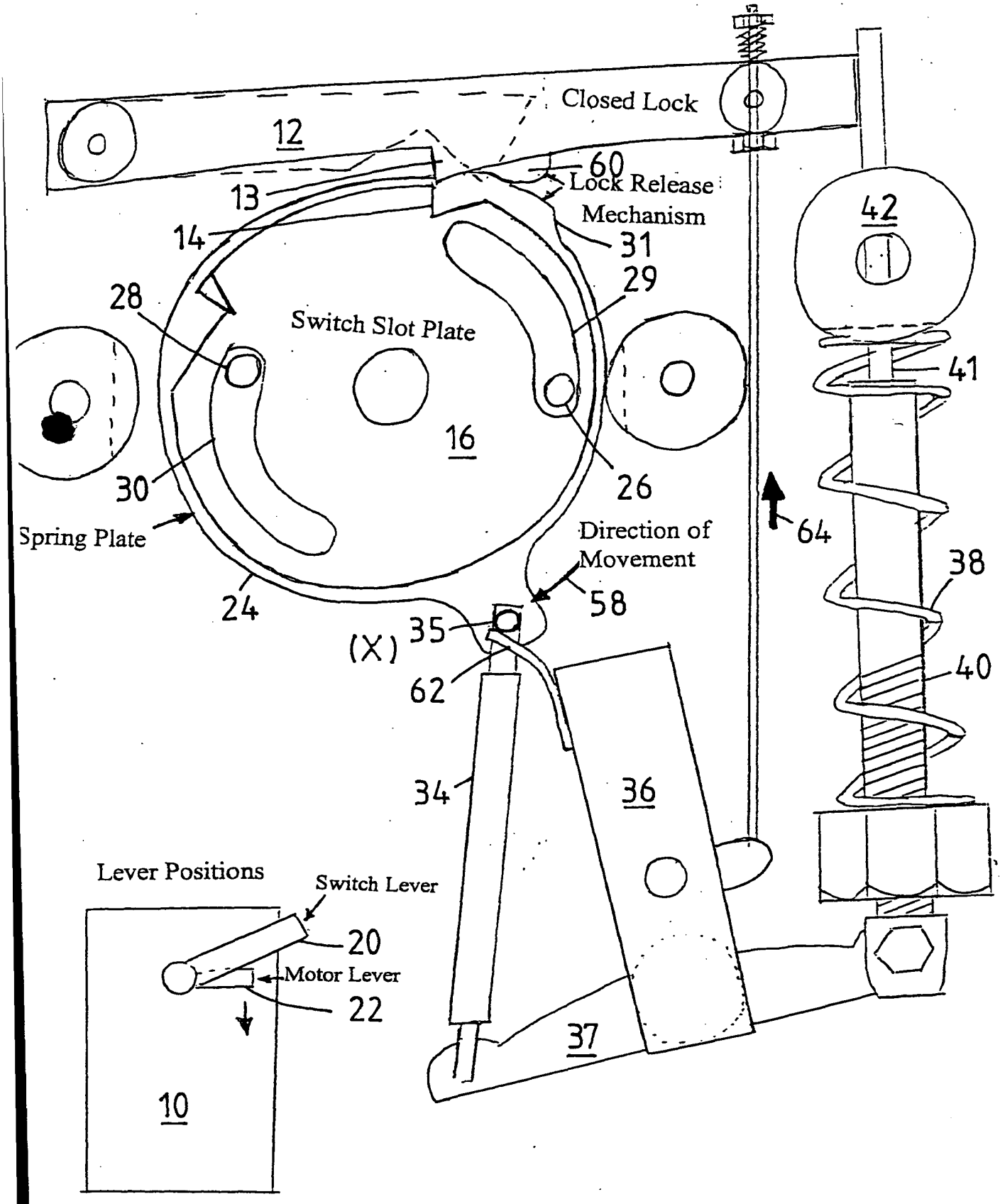
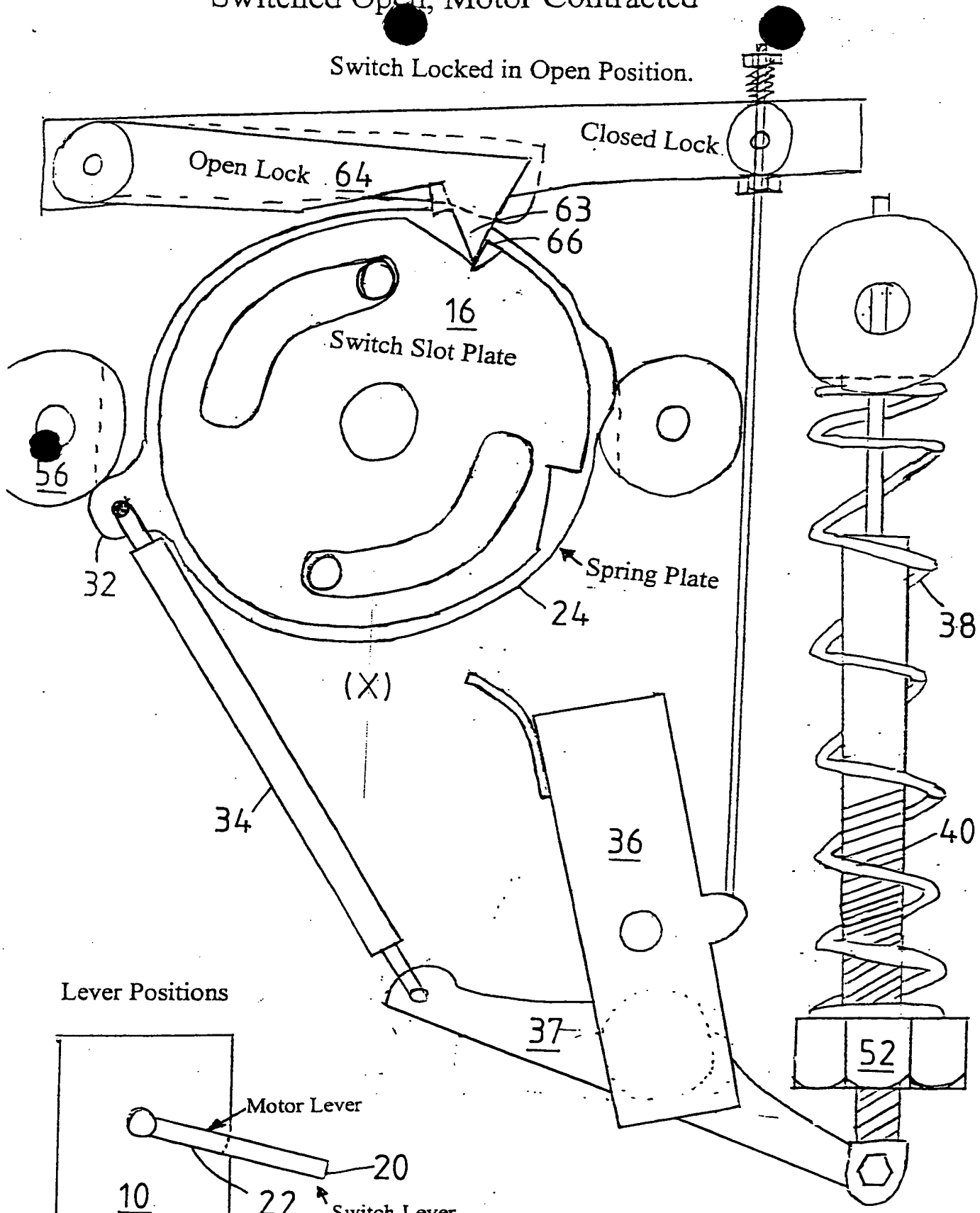


FIG. 3a

FIG. 3

Switched Open, Motor Contracted

Switch Locked in Open Position.



Lever Positions

FIG. 4a

FIG. 4

Switch Open, Motor Extending

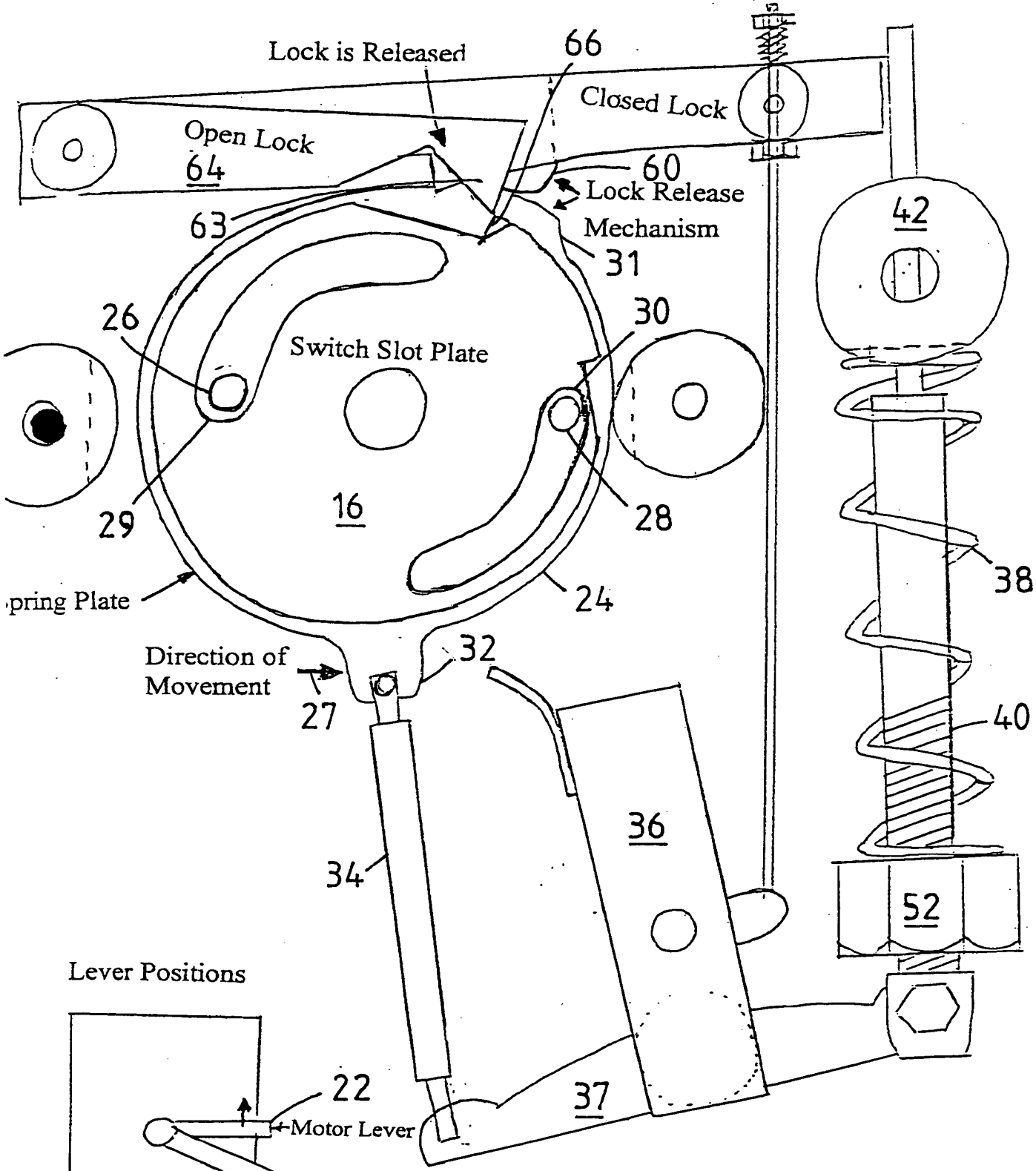


FIG. 5a

FIG. 5

Cross Section of Actuator Plates

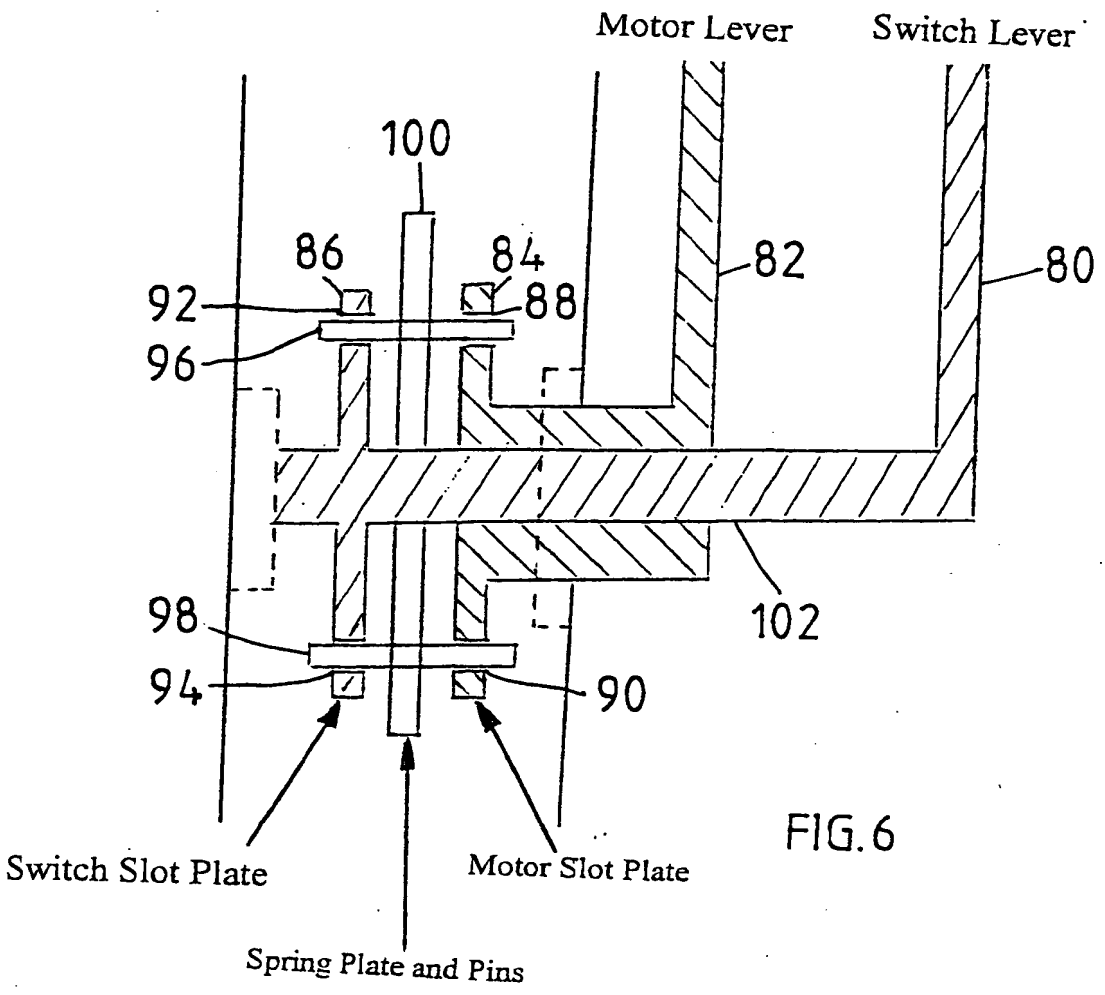


FIG. 6